



FAA-C-2818

October 20, 1987

**DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION**

CONSTRUCTION OF SMALL FIBERGLASS BUILDING
FOR ELECTRONIC EQUIPMENT

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1-1 SUMMARY OF WORK

1-1.1 General.-- These specifications, together with the referenced specifications, standards and drawings specified in the Contract Documents, cover the requirements of the Federal Aviation Administration, hereinafter referred to as the Government or FAA, for all work associated with the construction of a small fiberglass building to house electronic equipment.

1-1.2 Scope.-- The work includes the construction of a 6 foot by 8 foot small fiberglass equipment shelter including concrete foundation; electrical work and air-conditioner; installation of access driveway and parking area (fenced-in area) to include grading, subgrade compaction, and installation and compaction of fill material and surface course; grading and compaction of plot area; installation of facility grounding system and the construction and installation of appurtenances to the foregoing as specified and indicated by the drawings or required by the FAA standard specifications which are a part of this contract.

1-1.3 Intent of specifications.-- This specification identifies all labor, materials, plant and equipment to perform the work required to construct the facility. All work performed and all materials and equipment used shall be subject to the approval of the Contracting Officer Representative (COR). This shall include, but not be limited to, testing, inspection, scheduling, reporting, and submittals.

1-1.4 Contract documents.-- Documents identified in Attachment 2 of Part III, Section J, as Drawings for the Site Work, Architectural, Structural, Mechanical, and Electrical form a part of the construction requirements for this project.

1-1.4.1 Construction per drawings.-- The construction of this facility shall be in accordance with the lines shown on the drawings. The contractor shall not use dimensions scaled from drawings.

1-1.5 Precedence of contract documents.-- In the event of a difference between the following contract provisions, the order of precedence to determine which provision shall govern is as follows:

- a. Section H - Special Contract Requirements
- b. Project Specifications, FAA-C-2818, Section J, Attachment 1
- c. Project Drawings, Section J, Attachment 2

Any discrepancies between the contract provisions, the specifications and the contract drawings shall be referred to the COR for a written determination in accordance with FAR 52 236-21, Specification and Drawings for Construction (April, 1984).

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1-1.6 Document sources.-

1-1.6.1 Federal specifications (FS).- The federal specifications and standards, and supplements, amendments, and indices thereto are prepared and issued by the General Services Administration of the Federal Government. They may be obtained from the Specifications Activity, Printed Materials Supply Division, Building 197, Naval Weapons Plant, Washington, D. C. 20407.

1-1.6.2 Publications.- Drawings are available for review at the FAA regional offices.

Copies of military documents may be obtained from the Commanding Officer, Naval Supply Depot, 6801 Tabor Avenue Philadelphia, Pennsylvania 19120, Attention: Code CDS.

Information on obtaining copies of Federal specifications and standards may also be obtained from General Services Administration offices in Atlanta; Boston; Chicago; Denver; Fort Worth; Houston; Kansas City, MO.; Los Angeles; New York; Philadelphia; San Francisco; Seattle; and Washington, D. C..

Copies of Illuminating Engineering Society documents can be obtained from the Illuminating Engineering Society, 345 East 47 Street, New York, New York 10017.

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1-2 SITE ACCESS, CONSTRUCTION LIMITS, USE OF FACILITIES AND WORK HOURS

1-2.1 General.-

1-2.1.1 Existing facility operations.- For construction on or in the immediate vicinity of an airport, it will be necessary to coordinate all construction activity so as not to interfere with the functions of the airport. The contractor shall perform all work with a minimum disruption to the FAA and airport operations. Any work performed within 500 feet of any active runway may require its closing. Advance notice of at least 24 hours of proposed work near an active runway must be given to the COR. All work shall be coordinated with the Airport Manager, Airport Traffic Control Tower, Airport Security and other contractors through the COR.

1-2.1.2 Construction limits and access.-

1-2.1.2.1 Construction limits.- The contractor shall confine operations, activities, storage of materials and employee parking within the designated areas, as indicated on the construction staging plan. Additional space the contractor deems necessary shall be obtained off site, at no additional cost to the Government.

1-2.1.2.2 Access to site.- Access to the site shall be as indicated on the drawings. The contractor shall maintain the security integrity of the site at all times. Any existing access roads including surface course, grading, and erosion protection shall be maintained by the contractor throughout the Contract term and be brought to "as-new" condition at the time of final inspection.

1-2.1.2.3 Damage to site.- Damage to existing paving, lawns, curbs, or sidewalks, caused by the contractor's activities shall be repaired. All costs of repairs shall be paid by the contractor. After notice to proceed and prior to the commencement of construction, the contractor and COR shall conduct joint inspections of the existing areas affected by the construction. Existing damage or defects shall be noted and will be used as the basis for determination of damages caused by the contractor's operations.

1-2.1.3 Inspection of site by contractor.- The contractor shall have carefully examined the premises to determine the extent of work and the conditions under which it must be done. On request to the COR, the contractor may obtain permission to make soil borings or probings.

1-2.1.4 Contractors' use of premises.-

1-2.1.4.1 Contractor shall have complete and exclusive use of the premises within the construction staging area limits for the execution of the work.

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- 1-2.1.4.2 Contractor shall assume full responsibility for the protection and safekeeping of products stored on the site.
- 1-2.1.4.3 The contractor and subcontractors shall maintain the job site in a neat and orderly condition. This includes the daily removal of rubbish, waste and tools, equipment and materials not required for the work in progress.
- 1-2.1.5 Government use and access to premises.- The Government reserves the right to enter the premises during the term of the contract for periodic work inspections. See Part I, Section F, FAR Clause 52.236-8 "Other Contracts" for work by other contractors.
- 1-2.1.6 Security requirements.-
- 1-2.1.6.1 Personnel list.- Contractor shall provide the COR with a list of contractor's personnel who will require access to the site. The list shall be kept current during project work. In the case of construction which takes place on an airport, the contractor shall provide all personnel with readily identifiable numbered badges during the period their access to the site is required. Badges shall be shown to the FAA security guard to enter the site, and shall be worn on outer clothes while at work in the site.
- 1-2.1.6.2 Security investigation.- Contractor's personnel may be subject to security investigation by FAA. Upon request by the COR, the contractor shall promptly complete all security forms provided by the COR.
- 1-2.1.6.3 Communication.- The contractor will be required to have radio-equipped vehicles for communications with the air traffic control tower while working in controlled airport operation areas.
- 1-2.1.6.4 Right to search.- Current procedures at FAA facilities located within airport boundaries include the "right to search." If in the judgement of the authorized security guard a cause to search a vehicle or the person of personnel exists, such search will be made.

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1-3 COORDINATION, LOCAL PERMITS AND TESTING

1-3.1 General.-

1-3.1.1 Project coordination.- The contractor shall prepare a detailed schedule of work and work layout to resolve conflicts and to ensure coordination of the work by different trades. It shall be the duty of the contractor to resolve all coordination conflicts that arise among the subcontractors.

1-3.1.2 Local permits.- The contractor shall apply and pay fees to obtain local building permits and inspection as required. See Part I, Section F, FAR Clause 52.236-7 for additional information.

This building is designed in accordance with the Uniform Building Code, the Uniform Plumbing Code, and the National Electrical Code. The contractor shall construct the building in compliance with these codes.

1-3.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

1-3.2.1 American Association of State Highway and Transportation Officials (AASHTO).-

T99	Moisture Density Relations of Soils Using a 5.5-Pound Rammer and 12-Inch Drop.
T191	Density of Soil in-Place by the Sand-Cone Method
T205	Density of Soil in-Place by the Rubber Ballon Method
T238	Density of Soil and Soil Aggregate by Nuclear Method (Shallow Depth)
M145	Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

1-3.3 Testing.-

1-3.3.1 Contractor's responsibility.- Cooperate with the testing laboratory and make available, without cost, samples of all materials to be tested. Contractor shall furnish such normal labor as is necessary to obtain samples at the project site and to assist in making slump tests, casting and curing concrete cylinders. Contractor shall advise the testing laboratory of the identity of material sources and instruct these suppliers to allow inspections by the laboratory representatives, and notify the testing laboratory sufficiently in advance of operations to allow for completion of initial tests and assignment of inspection personnel.

1-3.3.1.1 Selection and payment.- The Contractor shall select and pay for a qualified testing laboratory or laboratories to perform the requirements of this section.

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1-3.3.1.2 Rejected materials or workmanship.- All materials or workmanship or both which have been rejected by the COR by reasons of failure to conform to the requirements of the Contract Documents shall be removed and replaced with new, acceptable materials by the contractor at contractor's own expense. Contractor shall pay for testing of new materials which have been installed in place of rejected materials.

1-3.3.2 Test reports.- The testing laboratory shall furnish three copies of each report direct to the COR covering all of its determinations and all of its control services. Reports shall show all data customarily listed by the laboratory in reporting on quantities, qualities, and types of materials, together with their location in the project and applicable Specification Section. Form of reports shall be acceptable to the COR.

1-3.3.3 Testing procedures.-

1-3.3.3.1 General.- Initial soil borings, testing and resultant soil classifications will be accomplished by the FAA and copies of test results will be available in the COR's office. All subsequent testing for borrow material compaction and concrete shall be the responsibility of the Contractor. The FAA reserves the right to direct retesting in the event of failures and any retesting shall be at Contractor's expense.

1-3.3.3.2 Earthwork testing.-

1-3.3.3.2.1 Maximum density.- The maximum density of the soil types at the site or borrow material approved for use on this project shall be determined in accordance with AASHTO Designation T99 or another method approved by the COR.

1-3.3.3.2.2 Field density.- The field density shall be determined in accordance with AASHTO Designation T191, T205, T238, or another method approved by the COR.

1-3.3.3.2.3 Soil classification.- The classification of satisfactory soil materials shall be determined in accordance with AASHTO Designation M145 or another method approved by the COR.

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1-4 SUBMITTALS

1-4.1 General.-

1-4.1.1 Submittal requirements.- This paragraph is written as an adjunct to Clause 52.235-2(g), Federal Acquisition regulation (48 CFR Chapter 1). The requirements contained in this paragraph take precedence over Clause 52.236-2(g) requirements.

1-4.1.2 Prior to Notice to Proceed.- Specific shop drawings and/or submittal data currently listed and required by the various sections of this specification shall be submitted to the COR for approval. The following submittal items must be approved by the FAA prior to the Notice to Proceed:

Construction schedule
Reinforcing steel
Air-conditioner
Fiberglass building
Electrical equipment

1-4.1.3 Procedure.- Five complete sets of all shop drawings or product data or both shall be submitted and two sets will be marked and returned to the contractor. Each shop drawing, submitted for approval, shall have in the lower right hand corner, just above the title block, a 4 inch by 4 inch open space in which the COR can indicate action taken. All submittals shall be accompanied by transmittal letters identifying the contents of the submittal. Transmittal letters shall consist of one original and one copy. Submittals shall be made in adequate time for FAA review (30 calendar days maximum) with possible contractor resubmittal (15 calendar days maximum) and FAA resubmittal review (15 calendar days maximum) before the work, which the respective submittal represents, is fabricated or delivered to the site. Work requiring approval shall not be initiated prior to approval of submittal. Submittals shall be checked by the contractor and coordinated with the work of other trades involved before they are submitted for approval. Submittals shall be complete, detailed, and assembled in sets. Lack of completeness or inadequate description will be justification for disapproval. Shop drawings shall bear the following information:

Number of contract drawings and latest revision;
Specification page and paragraph number;
Name of project or facility;
Name of contractor and subcontractor or supplier; and
Clearly identified contents and location of work.

1-4.1.4.- By submitting shop drawings, the contractor has determined and verified the following:

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Space limitations;
Coordination with equipment furnished under other specification sections;
Catalog numbers and similar data;
Compliance with requirements of the work and of the contract documents.

1-4.1.5 Shop drawing approval.-- The checking, marking or approval of the shop drawings and/or product data by the COR shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Approval will not relieve the contractor of the responsibility for any error which may exist. The contractor shall be responsible for the dimensions and design of adequate connections, details, and satisfactory construction of all work.

1-4.1.5.1 Approved as submitted.-- If "approved as submitted" is marked by the COR, each copy of the shop drawings or product data will be identified as having received such approval by being stamped and dated. After submittal has been approved, no substitution will be permitted without written approval by the COR.

1-4.1.5.2 Approved as noted.-- If "approved as noted" is marked by the COR, the shop drawings or product data is satisfactory contingent upon contractor acceptance of corrections, notations, or both and, if accepted, does not require resubmittal.

1-4.1.5.3 Not approved.-- If "not approved" is marked by the COR, the shop drawing or submittal data does not meet job requirements and the contractor must resubmit. If shop drawings or submittal data are disapproved, the contractor shall resubmit the corrected material, in the same quantity as specified for the original submittal.

1-4.1.6 Samples.-- The Government reserves the right to request samples of any products or materials proposed for use on this project. Specific samples currently listed under various sections of this specification will be required.

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1-5 TEMPORARY FACILITIES

1-5.1 General.-- Contractor shall provide and pay for all temporary services and facilities as specified below and as necessary for the proper and expeditious execution of the work. Contractor shall make, or have made, all connections to existing services and sources of supply as necessary and/or indicated and pay all charges for same. Contractor shall provide all labor, materials, equipment and appurtenances necessary for the complete installation, operation and maintenance of all temporary service systems and facilities. All work under this Section shall comply with applicable laws, rules, regulations, codes, ordinances and orders of all federal, state and local authorities having jurisdiction for the safety of persons, materials and property. Contractor shall remove all such temporary installations and connections when no longer necessary for the project work.

1-5.2 Temporary electric lighting and power.-- Contractor shall provide and maintain a temporary lighting and power system for construction and inspection purposes. Contractor shall make all necessary arrangements for temporary electrical services with the local power company to provide and pay for all temporary work or, at contractor's option, contractor shall provide an approved temporary engine generator at the project site.

1-5.3 Temporary water.-- Contractor shall make arrangements to furnish a potable water supply for project work, and pay for all temporary water and services.

1-5.4 Temporary toilets and sanitation.-- Contractor shall provide ample and suitable onsite sanitary conveniences with proper enclosures for the use of the workers employed on the work. Such conveniences shall be kept clean, be properly ventilated and shall be installed and maintained in conformity with requirements of all laws and ordinances governing such installations. Locations shall be subject to COR approval. After completion of the work such conveniences shall be removed from the site.

1-5.4.1 Toilets.-- Toilets shall be portable chemical type with screened enclosures, each having a urinal and closet and mounted on skids. Not less than one unit shall be provided for every 25 full-time employees.

1-5.4.2 Toilet servicing.-- Contractor shall be responsible for paying and arranging for each toilet unit to be serviced at least twice a week, including removal of waste matter, sterilizing, recharging tank, refilling tissue holders, and thorough cleaning and scrubbing of entire interior.

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1-6 MATERIALS AND EQUIPMENT

1-6.1 General.-- Material and equipment incorporated into the work shall conform to applicable specifications and standards and comply with size, make, type and quality specified, or as specifically approved in writing by the COR. Manufactured and fabricated products shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Like parts of duplicate units shall be manufactured to standard sizes and gages and shall be interchangeable. Two or more items of the same kind shall be identical and manufactured by the same manufacturer. Products shall be suitable for service conditions. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing. Do not use material or equipment for any purpose other than for which it is designed or specified. Furnish and install products specified, under options and conditions for substitution stated in this section.

1-6.1.1 Manufacturer's instructions.-- When contract documents require that installation of work shall comply with manufacturer's printed instructions, copies of such instructions shall be distributed to parties involved in the installation, including two copies to the COR. Maintain one set of complete instructions at the job site during installation and until completion. Products shall be handled, installed, connected, cleaned and conditioned in strict accordance with such instructions and in conformity with specified requirements. If job conditions or specified requirements conflict with manufacturer's instructions, the contractor shall consult with the COR for further instructions. All work shall be performed in accordance with manufacturer's instructions. No preparatory step or installation procedure shall be omitted unless specifically modified or exempted by contract documents.

1-6.1.2 Transportation and handling.-- Products shall be delivered in undamaged condition, in manufacturer's original containers or packing, with identifying labels intact and legible. Shipments shall be inspected to ensure compliance with requirements of contract documents and approved submittals, and that products are properly protected and undamaged immediately on delivery. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packing.

1-6.1.3 Storage.-- Products shall be stored in accordance with manufacturer's instructions, with seals and labels intact and legible. Products subject to damage by the elements shall be stored in weather-tight enclosures. Temperature and humidity shall be maintained within the ranges required by the manufacturer's instructions. Fabricated products shall be stored above the ground, on blocking or skids to prevent soiling or staining. Products which are subject to

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deterioration shall be covered with impervious sheet coverings and adequate ventilation shall be provided to avoid condensation. Loose granular materials shall be stored in a well-drained area on solid surfaces to prevent mixing with foreign matter.

1-6.1.4 Substitutions.-- A separate request for each substitution shall be submitted. Each request shall be supported with complete data substantiating compliance of proposed substitution with the requirements stated in the contract documents. Each request shall include product identification, manufacturer's literature including address, product description, reference standards and performance and test data. Samples shall be submitted as applicable. An itemized comparison of the proposed substitution with the product specified shall be included. The following information shall also be included: data relating to changes in the construction schedule; list of changes required in other work or products; and accurate cost data. Substitute products shall not be ordered or installed without written acceptance. The contractor represents that investigation of proposed products has proved that the products are equal to or superior in all respects to those specified; that the same warranties or bonds for substitutions as for product specified will be provided; that installation of accepted substitution into work will be complete in all respects; that claims for additional costs caused by substitution will be waived; and that cost data is complete and includes related costs under the contract.

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1-7/01

1-7 CONTRACT CLOSEOUT

1-7.1 General.-- The contractor shall require each subcontractor engaged upon the work to bear full responsibility for cleaning up during and immediately upon completion of his work. Rubbish, waste, tools, equipment and other apparatus caused by or used in the execution of his work shall be removed. This shall in no way be construed to relieve the contractor of his primary responsibility for maintaining the building and the site clean and free of debris, and leaving all work in a clean and proper condition acceptable to the COR. Exposed floor surfaces shall be protected against all mechanical damage, mortar or plaster droppings, oil, grease, or other damage that will stain or soil the cement finish. Protection shall be maintained until all work has been completed.

1-7.1.1 Rubbish removal.-- Immediately after unpacking, all packing material, case lumber, wrappings, or other rubbish, flammable or otherwise, shall be collected and removed from the building and the premises.

1-7.1.2 Overall cleaning.-- Immediately before the final inspection, the entire exterior and interior of the building and the surrounding areas shall be thoroughly cleaned by the contractor, including but not limited to the following:

Construction facilities, debris and rubbish shall be removed from the building and the site.

Finished surfaces within the building shall be swept, dusted, vacuumed, washed or polished as required.

Tools, scaffolding, temporary utility connections or buildings, belonging to the contractor or used under his direction shall be removed from the site.

1-7.2 Project record documents.--

1-7.2.1 Maintenance of documents.-- The following documents shall be maintained at the project site:

Contract drawings
Contract specifications
Addenda
Reviewed shop drawings
Change orders
Field test reports
Project correspondence
Other modifications to contract

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1-7.2.2 Storage and use of documents. Store record documents apart from documents used for construction; do not use record documents for construction purposes. Keep documents in clean, dry, legible condition; provide file cabinets and racks for storage of drawings.

1-7.2.3 Marking devices. - Use red colored pencil for all marking.

1-7.2.4 Recording and labeling.- Label each document "Project Record" in 1-inch high printed block letters. Keep record documents current. Do not conceal or cover up any item of work until the information has been recorded.

1-7.2.5 Submittals.- At completion of project, deliver record documents to COR. Accompany submittal with transmittal letter, containing the following:

Date

Project title and number

Contractor's name and address

Title and number of each record document

Certification that each document as submitted is complete and accurate

Signature of contractor, or his authorized representative

1-7.2.6 Contract documents.-

1-7.2.6.1 Contract drawings.- Legibly mark to record actual construction:

Depths of various elements of foundation in relation to grade floor level

Horizontal and vertical location of underground and overhead utilities and appurtenances referenced to permanent surface improvements

Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure

Field changes of dimension and detail

Changes made by change order or field order

Details not on originally specified drawings

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1-7.2.6.2 Contractor specifications and addenda.- Legibly mark each section to record:

Manufacturer, trade name, catalog number, and supplier of each item of equipment actually installed

Changes made by change order or field order

Other matters not originally specified

1-7.2.6.3 Shop drawings.- Shop drawings shall be maintained as record documents; legibly annotate drawings to record changes made after review.

1-7.3 Completion certificate.- When the work is completed, submit written certification that:

Contract documents have been reviewed;
Work has been inspected for compliance with contract;
Equipment and systems have been tested in the presence of the COR and are operational;
Required Operation and Maintenance manuals, data, and parts list have been submitted and approved;
Spare parts have been provided as required; and
Required instruction of maintenance personnel had been accomplished.

1-7.4 Final inspection.- The COR will schedule the final inspection upon approval and endorsement of the contractor's Completion Certification.

1-7.5 Punch list.- The COR will furnish the contractor with a list of discrepancies in the work, material and equipment noted during the final inspection.

1-7.6 Acceptance of work.- The contractor shall correct discrepancies noted during the final inspection, clean the premises and notify the COR that the work is ready for acceptance.

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2-1/01

2-1 CLEARING OF SITE

2-1.1 Scope.-- Clear, strip and grub the site.

2-1.2 Applicable documents.-- Not used.

2-1.3 Materials.-- Not used

2-1.4 Execution.--

2-1.4.1 Limit of operations.-- Confine operations to the required limits and take all precautions to protect the remainder of the property from damage.

2-1.4.2 Clearing and grubbing.--

2-1.4.2.1 Limits of work.-- Limits of clearing and grubbing shall be confined to the area within the perimeter fencing or the lease lines, and the area necessary to construct the access road. Clearing and grubbing shall consist of clearing the surface of the designated areas of all trees, stumps, brush, undergrowth, hedges, heavy growth of grass or weeds, fences, structures, debris, and rubbish of any nature, natural obstructions or such material which in the opinion of the COR is unsuitable for the foundation or pavements, or other required structures, including the grubbing of stumps, roots, matted roots, and the disposal from the project of all spoil materials resulting from clearing and grubbing.

Tap roots and other projections over 1-1/2 inches in diameter shall be grubbed out to a depth of at least 18 inches below the finished subgrade or slope elevation. Any trees or plant materials shown on the plans to be moved, shall be relocated as directed by the COR.

Any buildings and miscellaneous structures shown on the plans to be removed shall be demolished or removed. Materials designated to be removed, shall be removed from the site. The remaining or existing foundations, and all like structures shall be destroyed by breaking out or breaking down the materials of which the foundations are built to a depth at least two feet below the existing surrounding ground. Broken concrete, masonry units, or other objectionable material which cannot be used in backfill shall be removed and disposed of. The holes or openings shall be backfilled with acceptable material and compacted.

Holes remaining after the grubbing operation shall have the sides broken down to flatten out the slopes, and filled with acceptable material, moistened and properly compacted in layers to the density required in Section 2-3, EXCAVATING AND BACKFILLING.

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2-2 SITE GRADING

2-2.1 Scope.-- Uniformly grade areas within limits specified including adjacent transition areas.

2-2.2 Applicable documents.-- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

2-2.2.1 American Association of State Highway and Transportation Officials (AASHTO).--

T99 Moisture Density Relations of Soils Using a 5.5-Pound Rammer and 12-Inch Drop

2-2.3 Materials.-- Not used.

2-2.4 Execution.--

2-2.4.1 Grading outside building lines.-- Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes.

2-2.4.1.1 Low or unsurfaced areas.-- Finish areas to within no more than 0.10 feet above or below required elevation.

2-2.4.1.2 Surfaced area.-- Shape subgrade under surfaced areas to line, grade and cross-section, with finish surface not more than 1/2 inch above or below required subgrade elevation.

2-2.4.2 Compaction.-- After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

2-2.4.2.1 Testing for compaction.-- The required compaction tests shall be performed by the approved testing laboratory. The maximum density for each class of material shall be in accordance with AASHTO T99. The field density shall also be determined by AASHTO T99.

2-2.4.2.2 Surfaced areas and building slab subgrade.-- Make at least one field density test of subgrade for every 2000 square feet of surfaced area or building slab, but in no case less than three tests. In each compacted fill layer, make one field density test for every 2000 square feet of overlaying building slab or surfaced area, but in no case less than three tests.

2-2.4.3 Disposal of excess materials.-- Remove from the site excess earth and excavated materials unsuitable for fill, including trees, stumps, and rubbish. Removal and disposal shall be in conformance with Government, airport and local regulations.

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2-2.4.4 Maintenance.-

2-2.4.4.1 Protection of graded areas.- Protect graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerance.

2-2.4.4.2 Reconditioning compacted areas.- Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

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2-3/01

2-3 EXCAVATING AND BACKFILLING

2-3.1 Scope.-- Excavate, fill and backfill for structures, access road, fenced-in area and electrical facilities.

2-3.2 Applicable documents.-- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

2-3.2.1 American Association of State Highway and Transportation Officials (AASHTO).--

M145	Classification of Soils and Soil Aggregate Mixtures for Highway Construction Purposes
T99	Moisture Density Relations of Soils Using a 5.5-Pound Rammer and 12-Inch Drop

2-3.3 Materials.--

2-3.3.1 Crushed stone - type and size.-- Crushed stone shall consist of crushed gravel or crushed rock which is hard, strong, durable, free from adherent coatings, and shall contain no soft, thin or elongated pieces, dirt, or organic material. Material shall be secured from an acceptable source off-site. 1-1/2 inch maximum particle size and maximum two percent by weight passing size 4 sieve.

2-3.3.2 Earth fill.-- Fill shall be well graded inorganic fill, with 100 percent passing a 3 inch sieve, and 5 percent to 15 percent passing a No. 200 sieve, and having a plasticity index of 5.0 or less. Fill required under access road shall conform to AASHTO M-145, Group A-2.

2-3.3.3 Borrow.-- Excavated material from the site that is suitable as approved by the COR, may be used for filling or backfilling. Procure any additional material as necessary for site fill from approved borrow pits.

2-3.3.4 Filtration/separation fabric.-- A non-woven fabric, needle punched and heat fused of 100 percent polypropylene staple fiber; permeable to moisture transmittal, minimum 4.5 ounces per square yard; and conforming to the following additional criteria:

Grab strength, length direction. 1b. = 90
Grab strength, width direction, 1b. = 110
Elongation at break, length direction, percentage 65
Elongation at break, width direction, percentage 65
Coefficient of permeability K, c/Sec 5×10^{-2}

2-3.4 Installation.-

2.3.4.1 Excavating extent.- Excavation is unclassified and includes the removal of all materials including earth and rock of any type and obstructions of any type, either natural or man made. Excavate to the depths and dimensions indicated for footings, piers, slabs on grade, and other structures. In the event unsuitable or unstable soil is encountered below this limit, the COR will determine the depth of removal of such soil. Cut sides and bottom of footing excavations clean. Allow sufficient room for installation and inspection of forms.

2.3.4.1.1 Unauthorized excavation and low areas.- Where the excavation is carried beyond the lines indicated, fill to the indicated subgrades as follows:

2-3.4.1.1.1 Footings and piers.- Where soil bearing footings and piers for the new structures will occur, the fill shall be concrete of the same proportions as specified for footings and piers.

2-3.4.1.1.2 Slab on grade.- Earth fill as specified.

2-3.4.2 Protection of excavation.-

2-3.4.2.1 Grading.- Control the grade around excavations so that ground is pitched or dammed to prevent surface water from running into excavation.

2-3.4.2.2 Banks.- Protect exposed banks of excavation from washing and caving. If necessary, cover them with polyethylene sheet or use other approved means.

2-3.4.3 Filling and backfilling.-

2-3.4.3.1 General.- Unless otherwise specified, place all fills and backfills in layers compatible with compaction requirements, but not in layers exceeding eight inches for the entire width so that each layer can be uniformly and properly compacted.

2-3.4.3.2 Filling and backfilling under slabs.- Remove forms, lumber, trash, and other objectionable material and install fill and backfill in equal layers compatible with the equipment being used. Compact each layer as specified. Backfill as the work progresses. Selected materials from excavations, meeting specified requirements, and having the plasticity index specified will be acceptable. Compaction shall be equal to that of the undisturbed soil. Grade final layer to required elevation and dress smooth.

2-3/03

- 2-3.4.3.3 Filling and backfilling under access road and fenced-in area.- Remove forms, lumber, trash and other objectionable material and place fill and backfill in layers not over six inches loose measure. Compact each layer as specified.
- 2-3.4.3.4 Backfilling exterior conduit trenches.- After conduit has been checked, or tested if required, and have been approved, backfill trenches with fine, loose earth, free from large clods or stones, carefully deposit on both sides of the conduit and thoroughly tamp until enough fill has been placed to provide a cover at least one foot above the conduit. Place the remainder of the backfill in layers and compact as specified. After backfilling, dress off trenches to conform to adjacent contours. If trenches are improperly filled or if settlement occurs, they shall be refilled and redressed at not cost to the FAA. Maintain backfill areas and refill and redress areas that have settled.
- 2-3.4.4 Installing filtration/separation fabric.- Surface to receive fabric shall be prepared as specified. Material shall be placed according to the manufacturer's instructions. At time of installation the fabric will be rejected if it has rips, flaws, deterioration, damage or defects incurred during manufacture, transport, storage or handling.
- 2-3.4.5 Installing crushed stone.- The crushed stone shall be spread evenly over the prepared subgrade, backfill, or filtration/separation media so that after rolling, the thickness of the course shall be as indicated. Maintain the grading of the material during spreading and rolling so that no segregation of sizes occurs and no pockets of fine material are formed.
- 2-3.4.6 Compaction requirements.-
- 2-3.4.6.1 Fill and backfill under slabs and structures.- Maximum density shall be 95 percent at optimum moisture in accordance with AASHTO T99.
- 2-3.4.6.2 Subgrade under access road and parking area.- Maximum density shall be 95 percent at optimum moisture in accordance with AASHTO T99, for a minimum depth of 12 inches.
- 2-3.4.6.3 Other areas.- Compact fill areas not described to 90 percent maximum density at optimum moisture in accordance with T99.
- 2-3.4.6.4 Equipment.- Approved compaction equipment making a minimum of four complete passes over the entire area.

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3-1/01

3-1 CONCRETE FORMWORK

3-1.1 Scope.-- Furnish and install forms and related work required for cast-in-place concrete.

3-1.2 Applicable documents.-- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification.

3-1.2.1 American Concrete Institute (ACI) Publications.--

318 Building Code Requirements of Reinforced Concrete

3-1.2.2 American Society for Testing and Materials (ASTM).--

A307 Low Carbon Steel Externally Threaded Standard Fasteners

3-1.2.3 U.S. Department of Commerce, Product Standard.--

PS1-66 Softwood Plywood - Construction and Industrial

3-1.3 Materials.--

3-1.3.1 Plywood.-- Plywood shall comply with PS1-66 and bear grade trademark of the American Plywood Association. B-B Plyform, Class 1, exterior, 5/8 inch thick minimum.

3-1.3.2 Accessories.-- Required type, size and finish.

3-1.3.3 Form coating.-- Non-staining chemical compound.

3-1.3.4 Anchor bolts and plates.-- See Section 13-1.

3-1.3.5 Tubular fiberforms.-- Spirally constructed of laminated plies of fiber. Wall thickness as recommended by the manufacturer to meet load requirements. Outside surface wax coated for moisture resistance. Inside surface coated with bond-breaker compound and fabricated so that finish concrete surfaces are smooth and free of spiral and seam marking.

3-1.4 Installation.--

3-1.4.1 General.-- Location of inserts, and anchors, will be furnished by building fabricator. Build such items into forms in a manner that will prevent displacement or damage to them during placing of concrete. Verify sizes and locations. Inspect all construction documents to ensure the proper installation of embedded items and provision of openings.

3-1/02

3-1.4.2 Forms for concrete.-

3-1.4.2.1 General.- Locate and construct forms accurately so that finished concrete will conform to shapes, lines, grades and dimensions indicated. Joints shall be vertical unless otherwise specified, and tight to prevent leakage.

Size forms so that reinforcing rods, ties, and other accessories have the minimum coverage required by the structural general notes. Thickness of concrete coverage shall be measured from face of vertical or horizontal bars and face of stirrups in beams. Coverage not indicated shall conform to ACI 318.

3-1.4.2.2 Plywood forms.- Contact surface shall be free of warpage, cupping and large or loose knots.

3-1.4.2.3 Ties and spreaders.- Lengths shall be as required to provide proper concrete thickness. When practical, locate and space ties and spreaders symmetrically both ways, in plumb tiers and level rows.

3-1.4.4 Form coating.- Coat the inside of forms in accordance with coating manufacturer's printed installation instructions.

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3-2/01

3-2 CONCRETE REINFORCEMENT

3-2.1 Scope.-- Fabricate and install reinforcing and the related accessories required for cast-in-place concrete.

3-2.1.2 Related work in other sections.--

Cast-in accessories and inserts: Examine other Sections for extent.

3-2.2 Applicable documents.-- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

3-2.2.1 American Society for Testing and Materials (ASTM) Publications.--

A185	Welded Steel Wire Fabric for Concrete Reinforcing
A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

3-2.2.2 American Concrete Institute (ACI).--

318	Building Code Requirements for Reinforced Concrete
-----	--

3-2.2.3 Concrete Reinforcing Steel Institute (CRSI).--

Manual of Standard Practice and Recommended Practice for Placing Reinforcing Bars

3-2.3 Materials.--

3-2.3.1 Reinforcing steel bars.-- ASTM A615, Grade 40, modified in accordance with ACI 318. Carrying rolled-on identifying marks to denote the mill location, bar size and type of steel.

3-2.3.2 Welded steel wire fabric.-- ASTM A185.

3-2.3.3 Metal accessories.-- As recommended by CRSI Manual of Standard Practice.

3-2.4 Installation.--

3-2.4.1 Marking.-- Use standard waterproof tags. All designations shall coordinate with the Structural Drawings.

3-2/02

3-2.4.2 Tolerance.-- The following are maximum allowable tolerances:

3-2.4.2.1 Fabrication.--

Sheared length:	Plus or minus 1 inch.
Depth of truss bars:	Plus 0 or minus 1/2 inch.
Stirrups, ties:	Plus or minus 1/2 inch.
All other bends:	Plus or minus 1 inch.

3-2.4.2.2 Placement.--

Concrete cover to form surfaces:	Plus or minus 1/4 inch.
Minimum spacing between bars:	1/4 inch.
Top bars in slabs:	
Members 8 inches or less deep:	Plus or minus 1/4 inch.
Crosswise of members:	Space evenly within 2 inches of stated separation.
Lengthwise of members:	Plus or minus 2 inches.
Maximum bar movement to avoid interference with other reinforcing steel, conduit or other embedded work:	1 bar diameter.

3-2.4.4 Fabrication of reinforcing bars.--

3-2.4.4.1 Forming.-- Unless noted otherwise, bend bars cold. Do not straighten or rebend without specific approval from COR. Torch cutting at the job will not be permitted without prior approval of the COR.

3-2.4.4.2 Laps and splices.-- Use a minimum number of splices. Lap splices in strict accord with ACI 318 or as indicated. Do not make splices at points of maximum stress. Stagger splices in adjacent bars.

3-2.4.5 Cleaning.-- Remove reinforcing scale, heavy rust, and any coating which would reduce bond.

3-2.4.6 Placement.--

3-2.4.6.1 Grade supported slabs.-- Support reinforcing on sheet metal chairs spaced 4 feet apart.

3-2.4.6.2 Welded wire fabric.-- Roll out flat in longest practical lengths. Lap joints one mesh plus 2-inches, 6 inches minimum. Offset end laps of adjacent widths to prevent continuous lap. Fasten ends and sides of mesh at 48 inches on center with tie wire.

3-2.4.6.3 Anchor bolts.-- If reinforcing conflicts with location of anchor bolts, or inserts required to be encased in concrete, submit prompt notifications so that revisions can be made before concrete is placed. No cutting of reinforcing will be permitted without prior approval from the COR.

3-2/03

3-2.5 Quality assurance.--

3-2.5.1 Submittals.-- Conform to procedures specified.

3-2.5.1.1 Shop drawings.-- Show sizes and dimensions for fabrication and placing reinforcing steel and bar supports. Include bar schedules, and diagrams of bent bars. Indicate marking system used to identify types of steel required.

3-2.5.1.2 Mill reports.-- Submit manufacturer's certified mill test sheets giving properties of steel used to fabricate reinforcing and location of mill.

3-2.5.2 Testing.-- If testing is ordered, furnish required test specimens and cooperate with the testing laboratory.

3-2.5.3 Storage.-- Store reinforcing not less than 6-inches above ground.

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3-3/01

3-3 CAST-IN-PLACE CONCRETE

3-3.1 Scope.-- Provide portland cement cast-in-place concrete.

3-3.2 Applicable documents.-- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

3-3.2.1 American Society for Testing and Materials (ASTM) Publications.--

C33	Concrete Aggregates
C94	Ready-Mixed Concrete
C150	Portland Cement
C260	Air-Entraining Admixtures for Concrete
C494	Chemical Admixtures for Concrete
C618	Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

3-3.2.2 American Concrete Institute (ACI).--

301 Structural Concrete for Buildings

3-3.2.3 U.S. Department of Commerce Commercial Standards (CS).--

CS-238 Polyethylene Sheet

3-3.3 Materials.--

3-3.3.1 Cement.-- ASTM C150, Type I Grey Portland Cement. The use of Type III permitted only with specific approval.

3-3.3.2 Stone aggregate.-- ASTM C33. Fine-Natural sand. Coarse-Gravel or crushed stone, 1-1/2 inch maximum.

3-3.3.3 Water.-- Potable.

3-3.3.4 Chemical admix.-- ASTM C494 Type A or D (Type E may be used in cold weather upon written approval) polymer type compound (lignon compounds not acceptable) in liquid form.

3-3.3.5 Air entraining admix.-- ASTM C260 liquid vinsol resin compound compatible with chemical admix used.

3-3.3.6 Vapor barrier.-- Six-mil, clear polyethylene sheeting, CS-238.

3-3.3.7 Fly ash.-- ASTM C618, Class C or Class F, loss on ignition shall not exceed 1 percent.

3-3/02

3-3.4 Installation.-

3-3.4.1 General.- Check with other trades prior to placing concrete to ascertain that their work is in place.

3-3.4.2 Cast-in anchors and accessories.- Carefully place items required to be cast into concrete.

3-3.4.3 Testing.- Provide material and cooperate with testing laboratory.

3-3.4.4 Retempering.- Concrete that is partially hardened shall not be retempered.

3-3.4.5 Strength tests.- Conform to the requirements of ASTM C94.

3-3.4.6 Minimum compressive strength.- 3000 psi at 28 days.

3-3.4.7 Structural concrete - proportioning.-

3-3.4.7.1 General.- Conform to ACI 301 Standards. The mix design is intended to produce concrete which, when cured, will have a 28-day compressive strength equal to or greater than that required. If the strength required is not attained with the minimum cement content, additional cement shall be used or other aggregate provided.

3-3.4.7.2 Proportioning of ingredients.- Determine mix proportions in conformance with ACI Standards using Method 1 or 2.

3-3.4.7.3 Chemical admix.- Quantity, preparation and mixing shall conform to admix manufacturer's directions for use at temperatures anticipated when concrete will be placed.

3-3.4.7.3.1 Option.- Admix may be used at the contractor's option. If used, adjust formulas for concrete mix to provide for it and obtain COR approval before concrete is ordered.

3-3.4.7.4 Air-entraining admix.- Conform to admixture manufacturer's directions for quantity, preparation and mixing.

3-3.4.7.5 Mixing.- Concrete shall be procured from an approved "ready-mixed" concrete plant as follows:

Transit or ready-mixed concrete and delivery operations - Conform to ASTM C94. Do not add water at the job unless prior approval is given. Record the amount of any added water on each copy of the Delivery Ticket. If water is added, mix batch an additional 1 minute per yard of concrete, at slow speed, before placing it. Use no concrete which has been held in a mixer truck longer than 1-1/2 hours.

3-3/03

3-3.4.8 Structural concrete - placement.-

3-3.4.8.1 General.- Conform to ACI 301 Standards. Verify that forms are clean and coated, and that reinforcing, pipes, conduit, sleeves, anchors, and other inserts required to be cast in concrete have been properly installed. Such work shall be inspected and approved before placing is begun.

3-3.4.8.2 Temperatures.- Do not place concrete unless temperature is at least 40°F and rising. For temperatures below 40°F, special approved methods will be required.

3-3.4.8.3 Method.- Place concrete in the forms as rapidly as practical by methods that will prevent loss or separation of the ingredients.

3-3.4.8.4 Compaction.- Thoroughly compact concrete during and immediately after placement by means of mechanical vibrators.

3-3.4.8.5 Forms.- If forms become displaced in any way during placing of concrete, immediately stop the operation and do not resume placing until forms have been rebraced and brought back to required lines and levels.

3-3.4.9 Structural concrete - special requirements.-

3-3.4.9.1 Excavated areas.- Excavation shall be inspected and approved before concrete is placed. Do not place concrete on wet or soggy ground without first laying and compacting a bed of broken stone or gravel of sufficient thickness to keep the mud from mixing with the concrete. Where water is present keep the level below the newly placed concrete during placing and for at least 24 hours thereafter.

3-3.4.9.2 Slabs.- Cover pipes and conduit with a minimum of 1 inch of concrete.

3-3.5 Quality assurance.-

3-3.5.1 Submittals.- Conform to procedures specified.

3-3.5.1.1 Concrete source submission.- Before ordering, submit and obtain approval of source of concrete, and source of dry-batch material.

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3-4/01

3-4 FINISHING AND CURING

3-4.1 General.-

3-4.1.1 Scope.- Finish and cure the cast-in-place concrete.

3-4.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

3-4.2.1 Federal Specifications (FS).-

UU-B-790 Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

3-4.2.2 American Society for Testing and Materials (ASTM) Publications.-

C171 Sheet Materials for Curing Concrete

3-4.2.3 American Concrete Institute (ACI).-

301 Structural Concrete for Buildings
302 Recommended Practice for Concrete Floor and Slab Construction

3-4.2.4 U.S. Department of Commerce Commercial Standards (CS).-

CS-238 Polyethylene Sheet

3-4.3 Materials.-

3-4.3.1 Waterproof paper.- ASTM C171, Type I or FS UU-B-790 reinforced Kraft paper.

3-4.3.2 Plastic sheet.- U.S. Commercial Standard CS-238 polyethylene sheet in 4 mil minimum thickness.

3-4.4 Installation.-

3-4.4.1 Tolerance - horizontal surfaces.- Conform to ACI 301.

3-4.4.1.1 General.- Edges of areas shall be level and true to line against forms. Screed surface using specially fabricated straight edges (not lengths of lumber) and wet screeds.

3-4/02

3-4.4.2 Finishes.-- Conform to ACI 301.

3-4.4.2.1 Apron.-- Trowel and medium broom finish with broom after concrete is hard enough to retain a scoring edges finished with edging tool.

3-4.4.3 Curing.--

3-4.4.3.1 General.-- Protect concrete from loss of moisture, rapid drying or temperature changes, injurious action by the sun, rain, flowing water, or frost, and mechanical injury, at a temperature not less than 50°F, from the time of placing until the end of the time of curing. Keep wood forms, left in place during curing, damp at all times to prevent opening at the joints and drying of concrete. No period during which moisture or warmth is lacking shall be counted effective for curing.

3-4.4.3.2 Methods.--

3-4.4.3.2.1 Duration.-- Cure concrete for at least 7 days. During curing time do not work on or allow traffic on aprons being cured.

3-4.4.3.2.2 Moist curing.-- Use one of the following methods:

Cover surface with cotton mats.

Keep surface covering constantly wet.

Cover surface with wetted burlap mats, placing burlap side down.

Lap joints between mats 3 inches or more.

3-4.4.3.2.3 Impervious sheet curing.-- Wet surface with fine spray then cover it with plastic sheet or waterproof paper. Lap joints at least 4 inches and seal with tape. Weight sheeting to prevent displacement. Repair tears and other damage.

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13-1/01

13-1 FIBERGLASS REINFORCED POLYESTER SHELTER

13-1.1 General.-

13-1.1.1 Scope.- Design, fabricate, assemble, transport and install at the site fiberglass shelter complete including: exterior door, frame, hardware, door canopy, air-conditioner, and electrical equipment and fixtures.

13-1.1.2 Related work in other sections.-

Site preparation, piers and slab:	DIVISIONS 2 and 3
Air-conditioner:	Section 15-1
Electrical equipment:	Section 16-1

13-1.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

13-1.2.1 American Society for Testing and Materials (ASTM).-

A123	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip
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13-1.2.2 Federal Specifications (FS).-

FF-H-106	Hardware, Builders' Lock and Door Trim
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13-1.2.3 U.S. Department of Commerce, Product Standards.-

PS1-66	Softwood Plywood - Construction and Industrial
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13-1.3 Materials.-

13-1.3.1 General.- Design shelter and the fastenings to the foundation to meet the following minimum structural requirements: wind load of 100 miles per hour; roof live load of 40 pounds per square foot; floor live load of 180 pounds per square foot; seismic zone 3; rated to stop a .22 caliber long rifle bullet at 100 feet.

13-1.3.2 Gel coat.- Pigmented polyester resin, minimum thickness between 15-20 mils. Series 943, Polycor Gel Coats as manufactured by Cook Paint and Varnish Company or an approved equal.

13-1.3.3 Framing lumber.- Wood blocking and floor joists shall be Standard Grade, maximum 19 percent moisture content.

13-1/02

13-1.3.4 Plywood.-- Exterior type, tongue and groove where indicated.

13-1.3.5 Resilient flooring.-- No-wax vinyl composition tile, 12 inches by 12 inches by 1/8 inch. Azrock Floor Products Co., or an approved equal. Adhesive a standard product of the tile manufacturer.

13-1.3.6 Standard products of shelter fabricator.--

Door:	2 feet 8 inches by 6 feet 0 inches by 2 inches thick, sandwich panel of molded gel coated fiberglass - reinforced polyester with a foam core. Provide a continuous neoprene weather-stripping seal around the perimeter.
Hinges:	4 inches by 4 inches, 1-1/2 pair Stainless steel with tamperproof fasteners.
Latches and levers:	Two, wedge-type, solid brass chrome plated
Door stop and holder:	Cast aluminum with anodized satin finish.
Door canopy:	Stainless steel
Fasteners, bolts and screws:	Stainless steel or another corrosion - resistant material.

13-1.3.7 Lockset.-- FS FF-H-106, Type 86J (ANSI 1000-26, Type F05) Ball knob design with escutcheon US32D, removable and interchangeable 7 pin core all as manufactured by Best Universal Lock Company, Inc., Indianapolis, Indiana. No substitutes will be accepted

13-1.4 Fabrication.--

13-1.4.1 General.-- The shelter shall consist of a molded fiberglass-reinforced polyester sandwich dome secured to a sandwich floor panel supported on a galvanized steel beam assembly. The dome shall comprise the roof and side walls. The doorway shall be an integral part of the dome.

13-1.4.2 Dome.-- The exterior and interior shell shall be a one-piece molded gel coated fiberglass-reinforced polyester laminated with a nominal thickness of 1/8 inch. Exterior and interior surfaces shall be protected with an unbroken finish of pigmented isophthalic polyester chemically bonded to the shell. The void between the two shells shall be filled with closed cell urethane foam having an approximate density of 2 pounds per cubic foot (R12 minimum). Wood blocking for equipment attachment shall be 2 inches by 3 inches members installed continuously at each building rib. Exterior grade plywood laminate, 1/2 inch thick, shall be installed on the backside of the interior shell to support equipment at areas located between wood reinforced ribs. Blocking and plywood shall be installed prior to the urethane foaming process.

13-1/03

13-1.4.3 Floor.-- The floor shall be a sandwich panel construction consisting of a top floor covering of resilient tile applied to 1-1/8 inch thick tongue and groove plywood, 2 inch by 4 inch wood joists positioned flat on 2 foot centers with 2 inch by 3 inch blocking at the sides and 33 gage galvanized sheet metal fastened to the underside. Voids within the sandwich panel shall be filled with rigid polystyrene foam 1-1/2 inches thick.

13-1.5 Assembly.--

13-1.5.1 Dome.-- The dome shall be secured to the floor with 3/8 inch by 6 inches hot-dipped galvanized lag screws fastened through the floor into the fiberglass encased wood blocking at each rib of the dome. Additionally, the dome shall be adhesively bonded to the floor with a permanent elastic sealer in a continuous pour between the fiberglass skirt and the floor. The floor shall be bolted to the skid-beam assembly.

13-1.5.2 Skid-beam.-- The beam assembly shall consist of two hot-dip galvanized steel channel sections with lateral bracing angles. Removable steel extension plates shall provide four pick-up points to load, unload and transport the shelter. The steel skid assembly shall be galvanized in accordance with ASTM A-123.

13-1.6 Quality assurance.--

13-1.6.1 Manufacturer's qualifications.--

Regularly engaged in the fabrication of fiberglass shelters with existing plant facilities equipped for year around shelter manufacturing.

Capable of and experienced in transporting shelter to a remote site and installing same on prepared foundations using specialized trucks, trailers and cranes.

Plant capability to produce multiple shelters simultaneously.

13-1.6.2 Submittals, general.-- Conform to the procedures specified.

13-1.6.2.1 Shop drawings.-- Shelter plan and elevations, details of structural connections at floor, door and frame details, equipment connection to structure details. Plans and interior wall elevations showing the location and dimensions of air-conditioner panel, electrical equipment and required wall openings. Electrical schematics and equipment list, manufacturers literature and catalog cuts for equipment and finish materials. Calculations proving conformance of the shelter to the design criteria specified.

15-1/01

15-1 AIR-CONDITIONER, SELF-CONTAINED

15-1.1 General.-

15-1.1.1 Scope.- Furnish electric motor driven self-contained air-conditioner with mounting device.

15-1.1.1.1 Related work in other sections.-

Fiberglass Shelter: Section 13-1

15-1.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification.

15-1.2.1 Federal Specifications (FS).-

A-A-931 Air-Conditioner, Electric Motor Driven Self-Contained.

15-1.2.2 Federal Communications Commission Regulations.-

Part 15, Class A Computer Devices

15-1.3 Product and Materials.-

15-1.3.1 Air-conditioner.- FS A-A-931. Carrier, Model DVD 2081 or approved equal. Refer to drawing for nomenclature.

15-1.3.2 Direct digital automatic temperature control (DDC) system.-

15-1.3.2.1 System description.- Provide a system consisting of a preprogrammed control panel, and input/output devices to perform the sequence of operation indicated. The DDC panel programs (software), including the future remote maintenance and monitoring system (RMMS) functions, shall be factory installed and tested prior to shipment. All software shall be erasable programmable read only memory (EPROM) and enhanced EPROM resident to prevent loss of program on power failure.

15-1.3.2.2 FCC Regulations.- Computer based electronic equipment shall conform to the requirements of FCC Regulations Part 15, Section 15, 805 for Class A computer devices governing radio frequency electro-magnetic interference.

15-1.3.2.3 Fault tolerance.- Power supplies and system components requiring line voltage inputs shall be designed and tested to operate satisfactorily and without damage at 110 percent above and 85 percent below rated input voltage. Units shall also operate satisfactorily at ± 3 hertz variation in line frequency.

15-1/02

- 15-1.3.2.4 Fail-safe.-- Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors (i.e. control reverts to unoccupied cooling mode with indoor fan running). Loss of an input sensor shall result in output of a sensor failed message at the future RMMS.
- 15-1.3.2.5 Control panels.-- DDC panel shall be capable of collecting and processing data for future RMMS functions. The DDC panel shall continuously scan data inputs and outputs and maintain a local memory resident data file of current values and parameters assigned to individual points. Sensor inputs shall be converted, scaled, linearized, assigned offsets as required, and be transmitted to the future RMMS in 32-bit floating point format true values along with the appropriate engineering units. Analog commands received as true values from the future RMMS shall be converted by the DDC panel to actual output values compatible with the end control devices. Any volatile memory shall be backed for a minimum of 72 hours by nickel cadmium batteries with integral automatic recharging circuit. Direct digital control panel shall contain control algorithms and sequences necessary to provide stand alone environmental control over assigned equipment as indicated. Loss of DDC equipment communication with RMMS shall in no way inhibit or result in loss of digital control of air conditioner unit. Failure of any DDC shall be reported to the RMMS (where a printed record of a "no response" condition can be provided along with time of occurrence.
- 15-1.3.2.6 Control loops.-- All DDC loops shall be assigned EPROM (non-volatile) memory stored default values, or states, which are to be invoked on communication loss with the future RMMS. Totalizing software shall be provided at the DDC panel to allow accumulation of energy consumption data.
- 15-1.3.2.7 Input/Output devices.-- Input/Output devices shall be provided by the manufacturer of the DDC system and shall provide the functions indicated.
- 15-1.3.2.8 Acceptable manufacturer.-- Honeywell, Model R-7051A1057, or approved equal.
- 15-1.3.3 Testing control system.-- Calibrate and test all connected hardware and software to ensure that the system performs in accordance with the sequence of operation.
- 15-1.4 Installation.--
- 15-1.4.1 Air-conditioner.-- Install in accordance with the manufacturer's directions.

15-1/03

15-1.4.2 Control system.-- Control wiring shall be installed in conduit, neatly and parallel to shelter lines and surfaces. Mount the DDC control panel on an insulated base and attach panel to the wall so that the top of panel is at a height six feet above the floor.

15-1.4.3 Wiring.-- Refer to Section 16-1.

15-1.5 Quality assurance.--

15-1.5.1 Submittals.-- Conform to the procedures specified.

15-1.5.1.1 Test plan.-- Submit a test plan covering the system tests proposed for start-up and operation of the air-conditioning and DDC automatic temperature control system.

15-1.5.1.2 Product data. Submit manufacturer's catalog data completely describing components and devices incorporated into the air-conditioner and the DDC automatic temperature control system including control transformers, thermostats and relays.

15-1.5.1.3 Shop drawings.-- DDC equipment installation drawings including wiring diagrams.

* * * * *

Attachment 1 of 2

ROOM AIR-CONDITIONER

I. AIR HANDLING SECTION _____

- (a) Manufacturer _____
- (b) Model Number _____
- (c) Serial Number _____
- (d) Outdoor air temp _____ degrees FDB; _____ FWB
- (e) Room air temp _____ degrees FDB; _____ FWB
- (f) Evap coil ent air Temp _____ degrees FDB; _____ FWB
- (g) Evap coil lvg air Temp _____ degrees FDB; _____ FWB
- (h) Evap fan motor:
 - (1) Nameplate elec. service _____ volts, _____ phase, _____ cycles
 - (2) Nameplate current _____ amps
 - (3) Nameplate horsepower _____ hp
 - (4) Measured current and voltage (at motor terminals):
 - L1 _____ amps; _____ volts
 - L2 _____ amps; _____ volts
 - L3 _____ amps; _____ volts
 - (5) Measured fan speed _____ rpm
 - (6) Measured supply air quantity _____ cfm
 - (7) Measured outside air quantity _____ cfm
- (i) Capacity of Heating Coil _____ kW

Attachment 2 of 2

II. AIR-COOLED CONDENSING SECTION _____

(a) Refrigerant _____

(b) Compressor

(1) Suction pressure _____ psig

(2) Discharge pressure _____ psig

(3) High pressure cut-out _____ psig

(4) Low pressure cut-out _____ psig

(5) Nameplate elec. service ____ Volts, ____ phase, ____ cycles

(6) Nameplate current _____ amps

(7) Measured current and voltage (at motor terminals)

L1 _____ amps; _____ volts

L2 _____ amps; _____ volts

L3 _____ amps; _____ volts

(C) Condenser fan motor

(1) Nameplate elec. service ____ Volts, ____ phase, ____ cycles

(2) Nameplate current _____ amps

(3) Nameplate horsepower _____ hp

(4) Measured current and voltage (at motor terminals)

L1 _____ amps; _____ volts

L2 _____ amps; _____ volts

L3 _____ amps; _____ volts

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DIVISION 16 - ELECTRICAL

16-1 ELECTRICAL WORK

16-1.1 Scope.-- Furnish and install interior and exterior electrical equipment and materials.

16-1.2 Applicable documents.-- The current issues of the following documents in effect on the date of the invitation for bids form a part of this specification and are applicable to the extent specified herein.

16-1.2.1 Federal Specifications (FS).--

J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
W-B-30	Ballast, Fluorescent Lamp
W-C-375	Circuit Breakers, Molded Case; Branch Circuit and Service
W-C-586	Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical: Cast Metal - For Shore Use
W-J-800	Junction Box; Extension, Junction Box: Cover, Junction Box (Steel, Cadmium or Zinc - Coated)
W-P-115	Panel, Power Distribution
W-S-610	Splice, Conductor
QQ-W-343	Wire, Electrical Uninsulated
WW-C-566	Conduit, Metal, Flexible

16-1.2.2 Military specifications.--

MIL-P-15147	Primer and Enamel, Coal Tar
MIL-R-21931	Resin, Epoxy

16-1.2.3 National Fire Protection Association (NFPA) Publications.--

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16-1.2.4 National Electrical Manufacturers Association (NEMA) Standards.--

NEMA 1	General Purpose Enclosure
NEMA 3	Dusttight, Raintight and Sleet - (Ice) - Resistant Enclosure
WD1	General Purpose Wiring Devices

16-1.2.5 Underwriters Laboratories, Inc. (UL) Standards.--

UL 6	Rigid Metal Electrical Conduit
UL 50	Cabinets and Boxes
UL 98	Enclosed and Dead Front Switches
UL 514	Fittings for Conduit and Outlet Boxes

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UL 542	Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 1242	Intermediate Metal Conduit

16-1.3 Products and materials.--

16-1.3.1 Heavywall steel conduit.-- Heavywall zinc coated rigid steel conduit and fittings shall conform to UL 6 and UL 514. Rigid steel conduit may be used in all locations. Coated rigid steel conduit shall be used for installation below slab or grade, or underground. The conduit shall be factory coated with either .008 inch of epoxy resin in accordance with MIL-R-21931, .020 inch of polyvinyl chloride or .063 inch of coal tar enamel in accordance with MIL-P-15147, or field wrapped with .01 inch thick pipe wrapping plastic tape applied with 50 percent overlap. Fittings for use with rigid steel conduit shall be of the threaded type of the same material as the conduit. Where conduits enter boxes or cabinets without threaded hubs, double locknuts shall be used plus a phenolic insulated metallic bushing on the open end.

16-1.3.2 Intermediate steel conduit.-- Intermediate zinc coated rigid steel conduit and fittings shall conform to UL 1242 and UL 514 and bear the UL label. Only factory made sweep ells shall be used. Field bends are not permitted. Fittings shall be of threaded type and of the same material as the conduit. Where conduits enter boxes or cabinets without threaded hubs, use double locknuts and phenolic insulated metallic bushing on each open end.

16-1.3.3 Flexible steel conduit.-- Flexible steel conduit shall conform to FS WW-C-566. Use in 12 inch nominal lengths for terminal connections to motors or motor driven equipment, and use in short lengths for other applications as permitted by the NEC. Liquid tight flexible conduit shall be used outdoors or in wet locations. A separate ground conductor shall be provided across all flexible connections in addition to the green ground wire.

16-1.3.4 Conductors, uninsulated.-- Copper in accordance with FS QQ-W-343.

16-1.3.5 Conductors, insulated.-- Unless otherwise indicated, insulated conductors shall be copper with thermoplastic or thermosetting insulation, type THW, THWN, and XHHW for general use, or type THHN for use in dry locations only, all insulated for 600V in accordance with FS J-C-30. Conductors #10 AWG and smaller shall be solid, and conductors #8 AWG and larger shall be stranded. Minimum branch circuit conductor size #12 AWG. Minimum control wire size #14 AWG unless noted otherwise.

16-1.3.6 Wiring, fixture.-- Copper, with thermoplastic insulation type TF, TFF, TFN or TFFN insulated for 600 volts, in accordance with FS J-C-30.

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16-1.3.7 Boxes.-- Boxes shall be either the cast metal hub type conforming to FS W-C-586 or shall be one piece galvanized steel type conforming to FS W-J-800. Where not sized on the drawings, boxes shall be sized in accordance with the NEC. Provide boxes in the wiring or raceway system for pulling wires, making connections, and mounting devices or fixtures. Boxes for metallic raceways shall be of the cast-metal threaded hub type in wet locations, or surface mounted on outside of exterior walls, and in hazardous areas shall be explosion proof. Boxes in other locations shall be cast metal hub type or one piece galvanized steel with cover designed for surface installation. Each box shall have the volume required by the National Electrical Code for the number of conductors in the box. Each outlet box shall have a machine screw which fits into a tapped hole in the box for the ground connection. Boxes for mounting lighting fixtures shall be not less than 4 inches square.

16-1.3.8 Wiring devices.--

16-1.3.8.1 Receptacles - general.-- Receptacles shall be UL labeled and of the voltage and current rating indicated. All receptacles shall be "specification grade", side wired with two screws at each terminal. Unless noted otherwise, receptacles shall be installed 12 inches above finished floor. Receptacles shall be grounded by the installation of a green pigtail from the ground screw to the lug on the box where the green wire ground is connected. Receptacles shall have an ivory color finish.

16-1.3.8.1.1 Duplex.-- NEMA WD1, Type 5-15R. Unless otherwise indicated, general purpose duplex receptacles shall be 15 amp, 125 volt, grounding type.

16-1.3.8.1.2 240 Volt.-- NEMA WD1, type 6020R. Unless otherwise indicated, 240 volt receptacles shall be 20 amp, grounding type.

16-1.3.8.1.3 Ground fault interrupting.-- Receptacles shall be 15 amp, 120 volt, duplex, UL Group I, Class A. Exterior receptacles shall be mounted in waterproof cast outlet boxes with a waterproof cover.

16-1.3.9 Auxiliary generator receptacle.-- Heavy duty circuit breaking type, 4-wire, 3-pole, single phase, rated 60 amps, 250-volts. DC/600 VAC. Equipped with spring door and furnished with a matching plug for the generator receptacle.

16-1.3.10 Switches, wall.-- Wall switches shall be "specification grade", rated 120/277 volts, and fully rated 20 amps, A.C. only. Wiring terminals shall be of the screw type. Switches shall be the quiet operating type, and ivory colored. Not more than one switch installed

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in a single gang position. Unless indicated otherwise, switches shall be installed 48 inches above finished floor. Wall switches shall bear the U.L. label.

- 16-1.3.10.1 Switches, safety.- Safety switches shall conform to UL 98, heavy duty, unless otherwise indicated. Switches mounted in dry locations shall be in NEMA 1 enclosures. Switches installed outdoors, or in damp or wet locations shall be mounted in NEMA 3R enclosures. Switches shall be of the voltage and current ratings indicated, and each capable of interrupting the locked rotor current of the motor. The locked rotor current is assumed to be ten times the full rated load current. The switches shall be of the quick-make, quick-break type, parts shall be mounted on insulating bases to permit replacement of any part from the front of the switch. Current-carrying parts shall be of high-conductivity copper, designed to carry rated load without excessive heating. Switch contacts shall be silver-tungsten type or plated to prevent corrosion, pitting and oxidation and to ensure suitable conductivity. Safety switches shall be lockable in either position.
- 16-1.3.10.2 Switch, manual transfer.- Non-fusible double throw safety switch in a NEMA 1 enclosure, 240-volts, 100 amps, single phase, double pole factory installed solid neutral. Identify NORMAL-OFF-EMERGENCY positions. Square-D, Number DTU 223 NRB, or approved equal.
- 16-1.3.11 Device plates.- Plates on finished walls shall be of satin finish chromium plated brass. Screws shall be of metal with counter-sunk heads, in a color to match the finish of the plate. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed. Device plates for telephone and intercommunication outlets shall have a 3/8 inch bushed opening in center or dome shaped grommet on the side. Where required, device plates for telephones may be more than one piece type.
- 16-1.3.12 Photoelectric control.- Unless otherwise indicated, the photoelectric control for exterior entrance lights shall be 120 volt, 3000 watt, single pole, single throw, double break. Mount the photoelectric control in a waterproof watt hour meter socket.
- 16-1.3.13 Panelboards.- Panelboards shall conform to FS W-P-115 Type I, Class 1, and shall be listed by U.L. except for installations which require special panelboards to incorporate items not available as U.L. listed. All panelboards shall have a piano hinged door-in-door cover. All door hinges shall be concealed. Doors over 48 inches in height shall have auxiliary fasteners on top and bottom.
- 16-1.3.13.1 Gutters.- The minimum size of side wiring gutters shall be 4 inches for mains to and including 100 amps.

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16-1.3.13.2 Circuit breakers.-- Quick-make, quick-break, bolt on, thermomagnetic type, conforming to FS W-C-375, and U.L. listed. Circuit breakers shall be rated for the voltage of the circuit on which they are used, and have a minimum interrupting rating of 10,000 amperes, symmetrical for branch breakers, and 22,000 amperes symmetrical for main breakers. Circuit breakers shall have a trip indicating feature. Single pole breakers shall be a full size module, and two and three pole breakers shall be sized in even multiples of a single pole breaker. Size breakers so that two single pole breakers will not be capable of fitting in a single housing. Multipole circuit breakers shall have an internal common trip mechanism. Devices with an adjustable magnetic trip shall be factory set to the "low" value. Circuit breakers and the panelboards in which the breakers are installed shall be made by the same manufacturer. Self-enclosed circuit breakers shall be mounted in NEMA type 1 enclosures with trip rating, voltage rating and number of poles as indicated.

16-1.3.13.3 Bus bars.-- Buses shall be copper. Bus capacity shall be as indicated. Circuit breaker current-carrying connections to bus shall be of the bolted type, factory assembled. Stab-in types are not acceptable. Bus bar connections to branch circuit breakers shall be of the sequence phase type. Connect branch circuits to the individual circuit breakers as indicated. The neutral bus shall be insulated from panelboards. Panelboards shall have an uninsulated ground bus bolted to the cabinet, adequate in size to accommodate present and future equipment grounding conductors. Isolate ground bus from the neutral bus except at the service disconnect means. Where provisions for, future breakers are indicated, the panelboard shall be equipped with bus connections for future breaker installation.

16-1.3.14 Cabinets.-- Cabinets for the telephone and signal systems shall be constructed of code gage zinc coated sheet steel, and shall meet the requirements of UL Standard 50. Cabinets shall be constructed with interior dimensions not less than those indicated. Provide a 5/8 inch plywood backboard.

16-1.3.15 Fuses.-- Fuses shall have a voltage rating not less than the circuit voltage. Cartridge fuses shall have an interrupting rating as indicated, but if not indicated shall be not less than 100,000 amps when used in branch and distribution circuits, and not less than 200,000 amps when used in a service entrance switch.

16-1.3.16 Surge arrestor. 120/240-volts, single phase, 3-wire (centerground) 60-hertz, voltage range 90-135 VRMS phase to neutral, unlimited power rating, instantaneous response time. No delay, continuous conduction, extreme duty, discharge capacity 65,000 amps minimum life 2000 operations, temperature range minus 40°F to plus 140°F. Lightning Protection Corporation (L.P.C.) Catalog Number 20206-7 or approved equal.

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16-1.3.17 Lighting fixtures.-

16-1.3.17.1 General.- Lamps and lighting fixtures shall be of the types indicated, U.L. approved and bear the U.L. label. Incandescent lamps shall be rated for 120 volts.

16-1.3.17.2 Fluorescent fixtures.- Fixture lenses shall be the prismatic type, made of virgin acrylic. Lamps shall be rapid start, cool white. Ballasts shall be class P, rapid start, high power factor type conforming to FS W-B-30. Provide ballasts with choke type radio frequency interference suppressors. Ballasts shall bear the CBM/ETL label. Lampholders shall have silver plated contacts, and conform to U.L. Standard 542.

16-1.3.17.3 Incandescent fixtures.- Incandescent fixtures shall be provided for exterior lighting, type as indicated. Fixtures shall bear the U.L. label.

16-1.3.18 Grounding electrodes and conductor.- The grounding electrode conductor shall be bare copper. The rods shall be 3/4 inch diameter by 10 feet long copper-clad steel and of the sectional type.

16-1.3.19 Splices.- Solderless connectors for splices shall conform to FS W-S-610.

16-1.4 Installation.-

16-1.4.1 Wiring.-

16-1.4.1.1 General.- In the single phase system specified, not more than one of each of the ungrounded conductors shall be run with a common neutral. Neutral conductors shall extend from the neutral bus in the device where the active conductors originate. Device terminals for connection of more than one conductor shall be specifically designed for that purpose.

16-1.4.1.2 Raceways.- Minimum conduit size shall be 3/4-inch, but may be 1/2 inch for exposed control wiring. Each run shall be complete, fished, and swabbed before conductors are installed. Cap ends of conduit systems not terminated in boxes or cabinets. Exposed raceways shall be installed parallel to or at right angles with the lines of the structure. A pull wire shall be installed in empty tubing and conduit systems in which wiring is to be installed by other trades. The pull wire shall be No. 14 AWG zinc coated steel, or plastic with a minimum 200 pound tensile strength. Ten inches of slack shall be left at each end of the pull wire. Sections of raceways which pass through damp, concealed or underground locations shall be of a type specified for such locations, and extending a minimum of 12 inches beyond the damp, concealed, or underground area.

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Where conduit has to be cut in the field, cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and the same thread dimensions and taper as specified for factory cut threads on conduit.

16-1.4.1.2.1 Raceway support systems.- Raceways shall be securely supported and fastened in place at intervals of not more than 10 feet and within 3 feet of each outlet, junction box, cabinet or fitting. Fasteners as recommended by fiberglass shelter manufacturer.

16-1.4.2 Boxes.- Cast-metal boxes installed in wet location and boxes installed flush with the outside of exterior surfaces shall be gasketed. Separate boxes shall be provided for flush or recessed fixtures where required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes. Fasteners as recommended by the fiberglass building manufacturer.

16-1.4.3 Splicing.- Splices shall be made only at outlets, junction boxes, or accessible raceways. Use wire nuts to splice conductors sized #10 AWG and smaller, and compression connectors to splice conductors #8 AWG and larger. Splices shall be taped with electrical insulating tape in a manner which makes their insulation equal to the insulation on the conductors.

16-1.4.4 Device plates.- Plates of the one piece type shall be provided for all outlets and fittings to suit the devices installed. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plates shall be installed with an alignment tolerance of 1/16 inch.

16-1.4.5 Photoelectric control.- Install on the building exterior, faced in a northerly direction.

16-1.4.6 Service equipment.-

16-1.4.6.1 Power, general.- Service entrance equipment shall be in accordance with the regulations of the local utility providing service and the NEC. The power service entering the building shall have a clockwise phase rotation throughout the building.

16-1.4.6.1.1 Conduits.- Service entrance conduits shall be installed as indicated and shall be heavywall zinc coated rigid steel. Underground service entrance conduits shall be installed a minimum of 2 feet below finished grade.

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16-1.4.6.2 Disconnect switch.-- Switches used for service entrance disconnecting shall be fused disconnecting type and U.L. approved and labeled for use as service equipment.

16-1.4.6.3 Surge arrestor.-- Power surge arrestor shall be installed adjacent to (within one foot) and on the line side of the manual transfer switch as indicated. Connect the arrestor as recommended by the manufacturer.

16-1.4.6.4 Ground fault interrupting receptacles.-- Install ground fault interrupting receptacles at exterior outlets for general purpose 120 volt usage, and in other locations as indicated.

16-1.4.6.5 Auxiliary generator receptacle.-- Design for exterior mounting 3 feet and 6 inches above the finish floor line.

16-1.4.7 Panelboards.-- Panelboards shall be mounted so that the height to the top of the panelboard shall be 6 feet and 9 inches above the finished floor level. Directories shall be typed to indicate the load served by each circuit and mounted in a holder with protective covering. Arrange the directory so that the typed entries simulate the circuit breaker positions in the panelboard.

16-1.4.8 Cabinets.-- Cabinets shall be mounted so that the height to the top of the cabinet is 6 feet and 9 inches above finished floor level.

16-1.4.9 Fuses.-- A complete set of fuses shall be installed and one set of spares shall be furnished for each fusible device. Time/current tripping characteristics of fuses serving motors or connected in series with circuit breakers shall be coordinated for the proper operation.

16-1.4.10 Grounding.--

16-1.4.10.1 General.-- The grounding system shall be installed as indicated. The National Electrical Code shall govern, except where otherwise indicated.

16-1.4.10.2 Connecting grounding systems.-- Ground rods shall be interconnected by means of a buried, bare, No. 4/0 AWG copper cable. The cable shall be buried at least 2 feet below grade level or as indicated. Connections to the ground rods shall be made by exothermic welding or an approved type of high compression fitting except in access wells. Connections in access wells shall be made by means of UL approved and labeled connectors. The interconnecting cable shall close on itself forming a complete loop with the ends exothermically welded or connected with an approved pressure connector in an access well. The grounding electrode conductor for the electric service, sized in accordance with the NEC requirement shall be connected to the earth

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electrode system with a UL approved and labeled connector in an access well. Underground metallic pipes shall be connected to the earth electrode system by means of No. 2 AWG copper cable. Where routed underground, the interconnecting cables shall be bare. All connections shall be exothermically welded except where such welding could be hazardous. In these cases, bolted connections utilizing UL approved connectors shall be made. Bonding jumpers shall be sized to meet or exceed the NEC.

16-1.4.10.3 Access well.-- The access well shall be provided with a removable cover which can be locked. The access well shall provide space for testing the earth electrode system, connecting multipoint ground cables and future ground cables to the earth electrode system.

16-1.4.10.4 Equipment grounding.-- All electrical equipment, including light fixtures and receptacles shall be grounded by means of a separate green insulated ground wire (minimum of #12 AWG) routed within the raceway. The ground conductor shall be connected to the power panel or lighting panel equipment ground bus. All metallic non-current carrying parts of electronic equipment shall be grounded to the grounding system.

16-1.4.10.5 Primary power ground.-- Primary power shall be single phase, 3 wire, with one wire the neutral. At the service entrance safety switch, the neutral wire shall connect directly to the grounding grid. AC power distributed from the power distribution panel shall be 3 wire with the neutral isolated from ground.

16-1.4.10.6 Protection.-- Mechanical protection shall be provided for all cables in the ground system where they may be subject to damage. Protection shall be provided by conduit bonded to the cable at each end.

16-1.4.10.7 Raceway ground.-- Every component of metallic conduit runs such as individual sections, couplings, line fittings, pull boxes, junction boxes, and outlet boxes shall be bonded to the ground system. Bonding jumpers shall be sized to meet or exceed the National Electrical Code requirements.

Conduit brackets shall be securely bonded to the conduit and to the structure to which they are attached. Wireways shall be bonded at each joint with a #6 AWG ground conductor.

16-1.4.10.8 Electronic ground conductor.-- Electronic ground system is indicated on drawings. Ground conductor shall be separate from equipment ground conductor, color shall be green with yellow tracer. Connections of electronic equipment to the electronic ground and electronic ground to the counterpoise will be done by others.

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16-1.4.11 Identification.-

16-1.4.11.1 Nameplates.- Each of the following types of equipment shall be identified with a name plate which shows the functional name of the unit, voltage utilized, one or three phase as applicable, and any other pertinent information. Switches for local lighting shall not be identified.

Panelboards
Switches
A.C. Power surge arrestor
Generator receptacle assembly

Additional units of equipment shall also be identified if called for in the plans. Name plates shall be non-ferrous metal or rigid plastic, stamped, embossed or engraved with 3/8 inch minimum height lettering or numerals. The plates shall be secured to the equipment with a minimum of two screws.

16-1.4.11.2 Color coding.- Branch circuit and feeder conductors shall be color coded. The color coding shall be continuous throughout the facility on each phase conductor to its point of utilization so that the conductor phase connection is readily identifiable in any part of the installation. The equipment grounding conductor shall be as specified. Neutral conductors shall be continuous white. Where color coding is not available in the larger size conductors, the conductors shall be color coded by use of color coded tape, half lapped for a minimum length of 3 inches. Where conductors are color coded in this manner, they shall be color coded in junction and pull boxes, accessible raceways, panelboards, outlets and switches, as well as at terminations. Conductors in accessible raceways shall be coded in such manner that by removing or opening any cover, the coding will be visible.

Phase conductors shall be color coded as follows:

Single Phase

120/240 Volts

Line A - Black
Line B - Red

16-1.4.11.3 Conductor markers.- In addition to color coding, all line, phase, and neutral conductors shall be identified by plastic-coated, self sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved by the COR. Panel and circuit numbers shall be identified. Conductor identification shall be provided at terminations, and in junction boxes through which these

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conductors pass. Control circuit conductor identification shall be made by heat shrink tubing, permanently attached stamped metal foil markers, or equivalent means as approved by the COR. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable.

16-1.5 Quality assurance.-

16-1.5.1 Submittals.- Conform to the procedures specified.

16-1.5.1.1 List of materials and equipment.- Submit complete list of materials and equipment. List shall include manufacturer's style or catalog numbers. Catalog cuts or other descriptive data shall be furnished. Partial lists submitted from time to time are not considered as fulfilling this requirement.

16-1.5.1.2 Shop drawings.- Shop drawings shall be submitted for materials and equipment not completely identifiable by information submitted in the materials and equipment lists.

16-1.5.2 Tests.-

16-1.5.2.1 General.- Furnish instruments, materials and labor necessary to perform the following tests. Perform tests in the presence of the COR.

16-1.5.2.2 Insulation resistance.- Feeders and branch circuits shall have their insulation tested after installation, but before connection to fixtures or appliances. Motors shall be tested for grounds or short circuits after installation but before start-up. Conductors shall be free from short circuits and grounds, and a minimum insulation resistance phase-to-phase and phase-to-ground shall be 10 megohms measured with a 500 volt insulation resistance tester.

16-1.5.2.3 Neutral isolation.- After installation of branch circuits, the neutral in the service entrance switch shall be tested for isolation from ground with an ohmmeter set on its RX1 scale. The incoming neutral shall be temporarily disconnected to accomplish this test. Any contact between the neutral and ground (other than at the service entrance switch) is a possible cause of noise in electronic equipment and shall be corrected.

16-1.5.2.4 Earth resistance.- Submit in writing upon completion of the project the measured ground resistance of each ground rod indicating the location of the rod, resistance to ground, and the soil conditions at the time the measurements were made. After ground rods are installed, tie them together with the counterpoise and the resistance to ground of the entire system shall be measured before and after the

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connection of the earth resistance tester. The maximum ground resistance shall be 10 ohms. Where additional ground rods are required to achieve the specified resistance, the COR shall be notified before proceeding with additional work. The Earth Resistance Test equipment and test procedures shall be by the Biddle Manufacturing Company or equal.

16-1.5.2.5 Operating.-- After the interior wiring system installation is completed, and at such time as the COR directs, conduct an operating test. The equipment shall operate in accordance with the specified requirements.

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